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AEDC-TSR-78-V22

AUGUST 1978

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SEP 28 1990

DOC_NUM SER CN
UNC28889-PDC A 1

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TEST RESULTS FROM THE PRESSURE PHASE
OF THE FLOW DIAGNOSTICS APPLICATIONS TEST CONDUCTED
IN THE AEDC-VKF TUNNEL C

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Period Covered: June 26 - July 7, 1978

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AEDC-TSR-78-V22	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Test Results from the Pressure Phase of the Flow Diagnostics Applications Test Conducted in the AEDC-VKF Tunnel C	5. TYPE OF REPORT & PERIOD COVERED Final Report June 16, 1978 to July 7, 1978	
	6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) Kenneth W. Nutt and David H. Fikes, ARO, Inc., A Sverdrup Corporation Company	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Arnold Engineering Development Center Air Force Systems Command Arnold Air Force Station, Tennessee 37389	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Program Element 65807F	
11. CONTROLLING OFFICE NAME AND ADDRESS AEDC/OI Arnold Air Force Station TN 37389	12. REPORT DATE August 1978	
	13. NUMBER OF PAGES 25	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Available in DDC.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) pressure measurements cone surface pressures hypersonic flow		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Tests were conducted in the AEDC-VKF Hypersonic Wind Tunnel C to obtain pressure measurements on the tunnel nozzle wall and surface static pressures and pitot pressure on a 5-deg cone model with either a sharp or a blunt ($r_n = 0.375$ in.) nose. The pressure measurements were obtained to provide comparative data for laser scattering measurements of the temperature and number density of both the tunnel free-stream and the leeside of the 5-deg cone. The test was conducted at Mach number 10 with the tunnel stagnation pressure and temperature varying from 400 to 1480 psia and 750°R to 2160°R, respectively. The tunnel		

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dew point (frost point) varied from 394°R to 476°R. A test description is presented.

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NOMENCLATURE

d	Diameter of cone base, 6.0 in.
D	Diameter of Tunnel at test section entrance, 48.5 in.
l	Model length, 34.29 in.
M_{∞}	Free-stream Mach number
P_n	Tunnel nozzle wall pressure, psia
P_p	Pitot pressure, psia
P_s	Cone surface pressure, psia
P_{∞}	Free-stream static pressure, psia
P_o	Tunnel stilling chamber pressure, psia
q_{∞}	Free-stream dynamic pressure, psia
Re_{∞}/ft	Free-stream unit Reynolds number, ft^{-1}
r_b	Radius of cone base, 3.0 in.
r_n	Radius of cone nose, SHARP ≈ 0.0025 in. BLUNT = 0.375 in.
T_{DP}	Tunnel stilling chamber dewpoint temperature, $^{\circ}F$
T_o	Tunnel stilling chamber temperature, psia
$T_{C_{1-8}}$	Thermocouples one thru eight on cone model
x	Model axial coordinate, inches from sharp nose
x_T	Axial coordinate of Tunnel C nozzle, inches from throat (see Fig. 4)
θ	Circumferential location on Tunnel C nozzle, deg (0 on top of nozzle, positive clockwise looking upstream) see Fig. 4
ω	Cone circumferential location, deg (0 on top of cone, positive clockwise looking upstream) see Fig. 2.

1.0 INTRODUCTION

The work reported herein was conducted by the Arnold Engineering Development Center (AEDC), Air Force Systems Command (AFSC), under Program Element 65807F, Control Number 9R02-14-8, at the request of AEDC/Director of Test Engineering, Research Division (DOTR) for the von Karman Gas Dynamics Facility (VKF)/Aerospace Projects Branch (ASP). The AEDC/DOTR project monitor was Capt. S. L. Ludwig (CF) and the VKF/ASP project monitor was Mr. W. D. Williams. The results were obtained by ARO, Inc., AEDC Division (a Sverdrup Corporation Company), operating contractor for the AEDC, AFSC, Arnold Air Force Station, Tennessee. The test was conducted in the VKF Tunnel C (Fig. 1) under ARO Project No. V41C-V5. This test was in support of the AEDC/DOTR Flow Diagnostics Applications Test conducted under ARO Project No. V32I-P1.

The purpose of this test was to obtain cone pressure measurements and measurements of the tunnel free-stream flow conditions. These data were in support of laser scattering measurements of the temperature and number density of both the tunnel free-stream and the leeside of a 5-deg cone model obtained on the Flow Diagnostics Application Test.

Pressure data were obtained with the VKF standard 5-deg cone model and a pitot rake mounted in the plane of the model base. Tunnel conditions were recorded with the standard tunnel instrumentation system and nozzle wall pressures were obtained at selected locations on the Mach 10 nozzle. The test was conducted at Mach 10 at stagnation pressure levels varying from 400 to 1480 psia and stagnation temperature levels ranging from 750°R to 2160°R. The tunnel dew point temperature was varied from 394°R (-66°F) to 479°R (19°F).

A microfilm copy of the data is on file at AEDC. Requests for these data should be addressed to AEDC/DOTR, Arnold AFS, TN 37389.

2.0 APPARATUS

2.1 TEST FACILITY

Tunnel C is a closed-circuit, hypersonic wind tunnel with a Mach number 10 axisymmetric contoured nozzle and a 50-in.-diam test section. The tunnel can be operated continuously over a range of pressure levels from 200 to 2000 psia with air supplied by the VKF main compressor plant. Stagnation temperatures sufficient to avoid air liquefaction in the test section (up to 2160°R) are obtained through the use of a natural gas fired combustion heater in series with an electric resistance heater. The entire tunnel (throat, nozzle, test section, and diffuser) is cooled by integral, external water jackets. The tunnel is equipped with a model injection system, which allows removal of the model from the test section while the tunnel remains in operation. A description of the tunnel may be found in the Test Facilities Handbook*.

*Test Facilities Handbook (Tenth Edition). "von Kármán Gas Dynamics Facility, Vol. 3" Arnold Engineering Development Center, May 1974.

2.2 TEST ARTICLE

The test article was the VKF standard 5-deg pressure cone model (Fig. 2) with a pitot rake mounted to measure pressures in the plane of the model base (Fig. 3). The cone is approximately 34 inches long with a 6-in. base diameter. Two interchangeable noses were tested on the cone model; a 0.375-in. radius blunt nose and a nominally sharp nose (see Fig. 2). The cone model had 68 surface pressure taps (0.063-in. I.D.) in four longitudinal rows spaced 90 deg apart (see Table 1). Each row consisted of 17 pressure taps that were equally spaced. Eight Chromel®-Alumel® thermocouples were mounted on the internal wall of the model. Four of the thermocouples were located at $x/l = 0.578$ and four were at $x/l = 0.925$. At both stations, the thermocouples were 90 deg apart and in line with the four longitudinal rows of pressure taps. Only three of the thermocouples were operational for this test and their locations are shown in Table 1.

The pitot rake was mounted so the probe tips were located at $\omega = 0$ and $x/l = 1.0$ on the cone model. A sketch of the pitot rake showing the distance of each probe relative to the cone centerline is presented in Fig. 3.

The tunnel nozzle wall pressures were measured by taps numbered 101 through 109. The location of these taps along the nozzle wall are documented in Fig. 4.

A sketch of the standard cone model installed in the Tunnel C test section is shown in Fig. 5. The tunnel valve hookup information is included in Table 2.

2.3 TEST INSTRUMENTATION

2.3.1 Test Conditions

Tunnel C stilling chamber pressure is measured with a 500- or 2500-psid transducer referenced to a near vacuum. Based on periodic comparisons with secondary standards, the accuracy (a bandwidth which includes 95-percent of the residuals, i.e. 2σ deviation) of the transducers is estimated to be within ± 0.16 percent of reading or ± 0.5 psi, whichever is greater, for the 500-psid range and ± 0.16 percent of reading or ± 2.0 psi, whichever is greater, for the 2500-psid range. Stilling chamber temperature measurements are made with CR-AL thermocouples which have an uncertainty of $\pm(1.5^\circ\text{F} + 0.375 \text{ percent of reading})$ based on repeat calibrations (2σ deviation).

2.3.2 Test Data

Dewpoint temperature in the stilling chamber was measured with a Cambridge Research Laboratory (CRL) hygrometer. The estimated accuracy of these instruments is $\pm 2^\circ\text{F}$ based on the accuracy of the copper-constantan thermocouple measurement and periodic calibrations.

Surface pressures on the cone model, pitot rake pressures, and the tunnel nozzle wall static pressures were measured with the standard Tunnel C pressure system. The system is equipped with 15-psid Wiancko FM transducers and 1-psid MKS Baratron transducers both of which are referenced to a near vacuum. For the purpose of estimating data uncertainty, the accuracy of these pressure measurements is estimated to be $\pm 0.2\%$ of the reading or ± 0.01 psi, whichever is greater, for the 15-psid transducers and $\pm 0.3\%$ of the reading or ± 0.0015 psi, whichever is greater, for the 1-psid transducers.

The Chromel-Alumel thermocouples mounted on the internal wall of the cone model have an uncertainty of $\pm 2^\circ\text{F}$.

3.0 TEST DESCRIPTION

3.1 TEST CONDITIONS AND PROCEDURES

3.1.1 General

A summary of the nominal test conditions at each Mach number is given below.

M_∞	p_o , psia	T_o , $^\circ\text{R}$	q_∞ , psia	p_∞ , psia	$Re_\infty/\text{ft} \times 10^{-6}$
10.02	400	2080	0.61	0.009	0.4
	490	1800	0.77	0.011	0.7
10.08	780	890	1.25	0.017	3.5
10.11	825	1300	1.29	0.018	1.9
	825	1350	1.28	0.018	1.8
10.14	1420	1160	2.28	0.032	4.1
	1480	1275	2.37	0.033	3.7
	1450	1400	2.29	0.032	3.1
	1465	1440	2.30	0.032	2.9
	1470	1630	2.26	0.031	2.4
	1465	1800	2.22	0.031	2.0
	1470	1980	2.19	0.030	1.7
	1470	2160	2.15	0.030	1.4

The dewpoint temperature of the tunnel free-stream was the primary flow variable and was controlled between 394°R (-66°F) and 479°R (19°F).

A test summary showing all configurations tested and the variables for each is presented in Table 3.

In the VKF continuous flow wind tunnels (A, B, C), the model is mounted on a sting support mechanism in an installation tank directly underneath the tunnel test section. The tank is separated from the tunnel by a pair of fairing doors and a safety door. When closed, the fairing doors, except for a slot for the pitch sector, cover the open-

ing to the tank and the safety door seals the tunnel from the tank area. After the model is prepared for a data run, the personnel access door to the installation tank is closed, the tank is vented to the tunnel flow, the safety and fairing doors are opened, and the model is injected into the airstream, and the fairing doors are closed. After the data is completed, the model is retracted into the tank and the sequence is reversed with the tank being vented to atmosphere to allow access to the model in preparation for the next run. The sequence is repeated for each configuration change.

3.1.2 Data Acquisition

Three types of data were recorded for this test. These consisted of tunnel nozzle wall pressures, pitot rake pressure measurements at the base of the cone, and cone surface pressure measurements. The cone could be configured with either a sharp or a blunt nose ($r_n = 0.375$ in.). The desired type of data was selected for a data group by a manual input of a code number to the computer as listed in Table 4.

The tunnel nozzle wall pressures were obtained with the cone model retracted from the test section. The cone and rake data were obtained at nominal pitch and roll of zero degrees. The cone was aerodynamically aligned in the pitch plane so that the pressure taps at 0- and 180-deg were reading nominally the same pressure. This aerodynamic alignment or adjustment relative to the sector zero pitch position was about 0.02 degrees.

3.2 DATA REDUCTION

Prior to each operation shift, and as required, the 16, 1-psid transducers are all calibrated with a known pressure differential, and the 16, 15-psid transducers are all calibrated at one higher pressure level. A zero pressure differential is applied across each transducer and the zero readings are recorded.

From these data, scale factors for the single range of the 15-psid transducers and the 5 ranges of the 1-psid transducers are calculated. The range factors for the 1-psid transducers are;

<u>RANGE INDICATE</u>	<u>NOMINAL RANGE FACTOR</u>
1	0.01
2	0.03
3	0.10
4	0.30
5	1.00

For each data sample a port position (see Table 2) was selected for the desired pressure taps. The range for each of the 16 transducers (channels) was automatically recorded and the appropriate scale factor and zero reading were used to determine the pressure on each transducer.

3.3 UNCERTAINTY OF MEASUREMENTS

3.3.1 General

The accuracy of the basic measurements (p_o and T_o) was discussed in Section 2.3. Based on repeat calibrations, these errors were found to be

$$\frac{\Delta p_o}{p_o} = 0.0016 = 0.16\%, \quad \frac{\Delta T_o}{T_o} = 0.004 = 0.4\%$$

Uncertainties in the tunnel free-stream parameters and the pressure ratios were estimated using the Taylor series method of error propagation, Eq. (1),

$$(\Delta F)^2 = \left(\frac{\partial F}{\partial X_1} \Delta X_1 \right)^2 + \left(\frac{\partial F}{\partial X_2} \Delta X_2 \right)^2 + \left(\frac{\partial F}{\partial X_3} \Delta X_3 \right)^2 + \dots + \left(\frac{\partial F}{\partial X_n} \Delta X_n \right)^2 \quad (1)$$

where ΔF is the absolute uncertainty in the dependent parameter $F = f(X_1, X_2, X_3, \dots, X_n)$ and X_n are the independent parameters (or basic measurements). ΔX_n are the uncertainties (errors) in the independent measurements (or variables).

3.3.2 Test Conditions

The accuracy (based on 2σ deviation) of the basic tunnel parameters, p_o and T_o , (see Section 2.3) and the 2σ deviation in Mach number determined from test section flow calibrations were used to estimate uncertainties in the other free-stream properties using Eq. (1). The computed uncertainties in the tunnel free-stream conditions are summarized in the following table.

Uncertainty, (\pm) percent of actual value				
M_∞	M_∞	P_∞	q_∞	Re_∞/ft
10.02	1.4	9.3	6.5	4.0
10.08	1.0	6.6	4.6	2.9
10.11	0.8	5.3	3.7	2.3
10.14	0.8	5.3	3.7	2.3

3.3.3 Test Data

The pressure measurement uncertainties listed in Section 2.3 were combined with uncertainties in the tunnel parameters, using the Taylor

series method of error propagation (Eq. 1), to estimate the uncertainty of the pressure ratio data, and these are presented below.

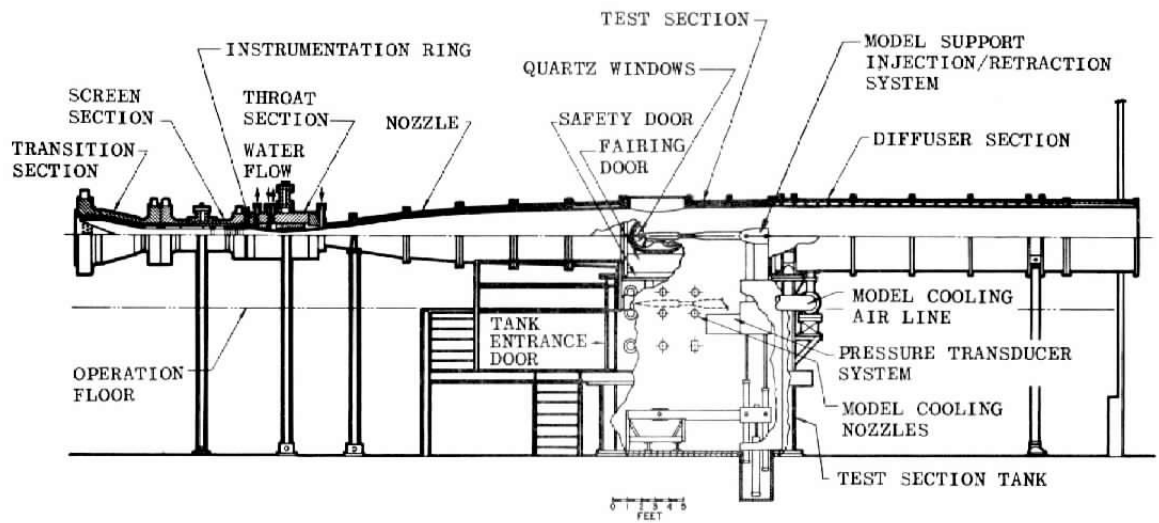
NOMINAL					RELATIVE UNCERTAINTY ± PERCENT			
p_o , psia	p_s , psia	p_p , psia	MAX. p_n , psia	MIN. p_n , psia	p_s/p_o	p_p/p_o	MAX. p_n/p_o	MIN. p_n/p_o
400	---	---	0.35	0.02	---	---	0.44	7.5
825	0.05	3.56	0.67	0.04	3.0	0.30	0.32	3.8
1470	0.1	4.67	1.25	0.05	1.5	0.24	0.81	3.0

4.0 DATA PACKAGE PRESENTATION

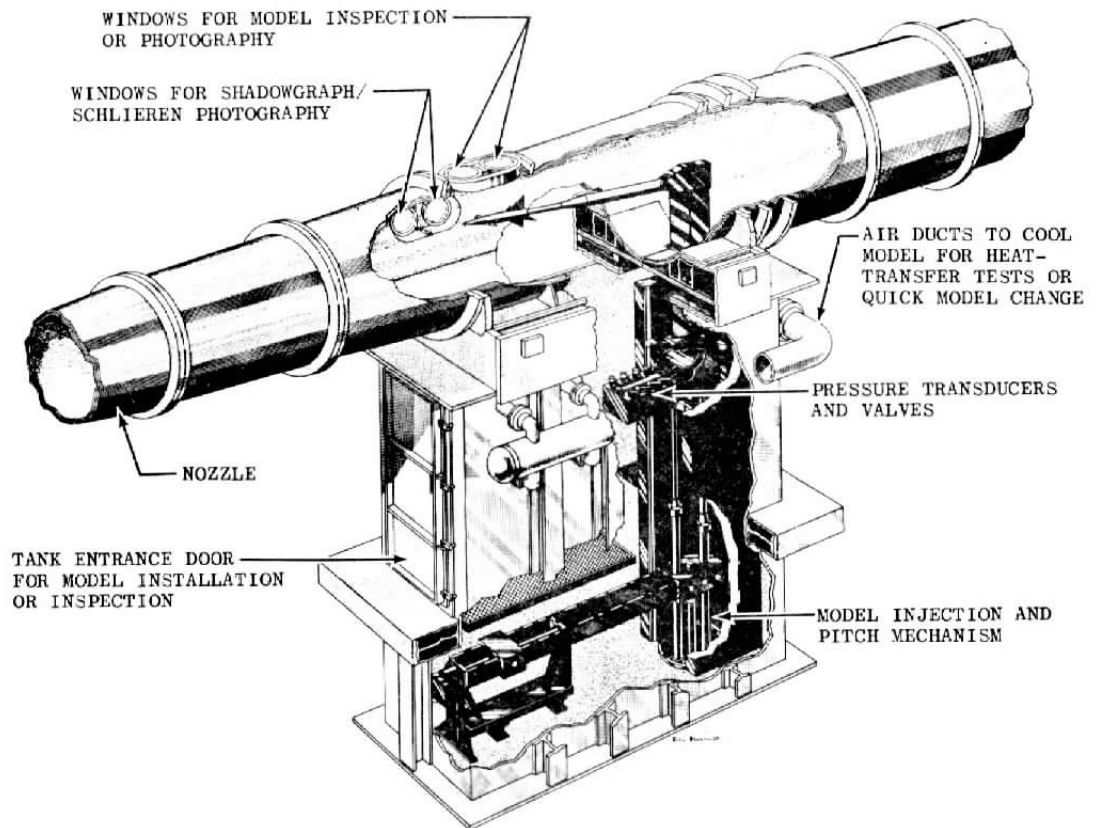
Tunnel flow conditions were obtained for each data group. Pressure data were obtained for either the tunnel nozzle wall pressures, rake pitot pressures, or cone surface pressures on the VKF standard 5-deg cone model. Typical tabulated data tabulations are illustrated in Appendix 3 for each type of data. The final tabulated data were transmitted with this report to VKF/ASP.

APPENDIX I

ILLUSTRATIONS



a. Tunnel assembly



b. Tunnel test section
Fig. 1 Tunnel C

All linear dimensions in inches

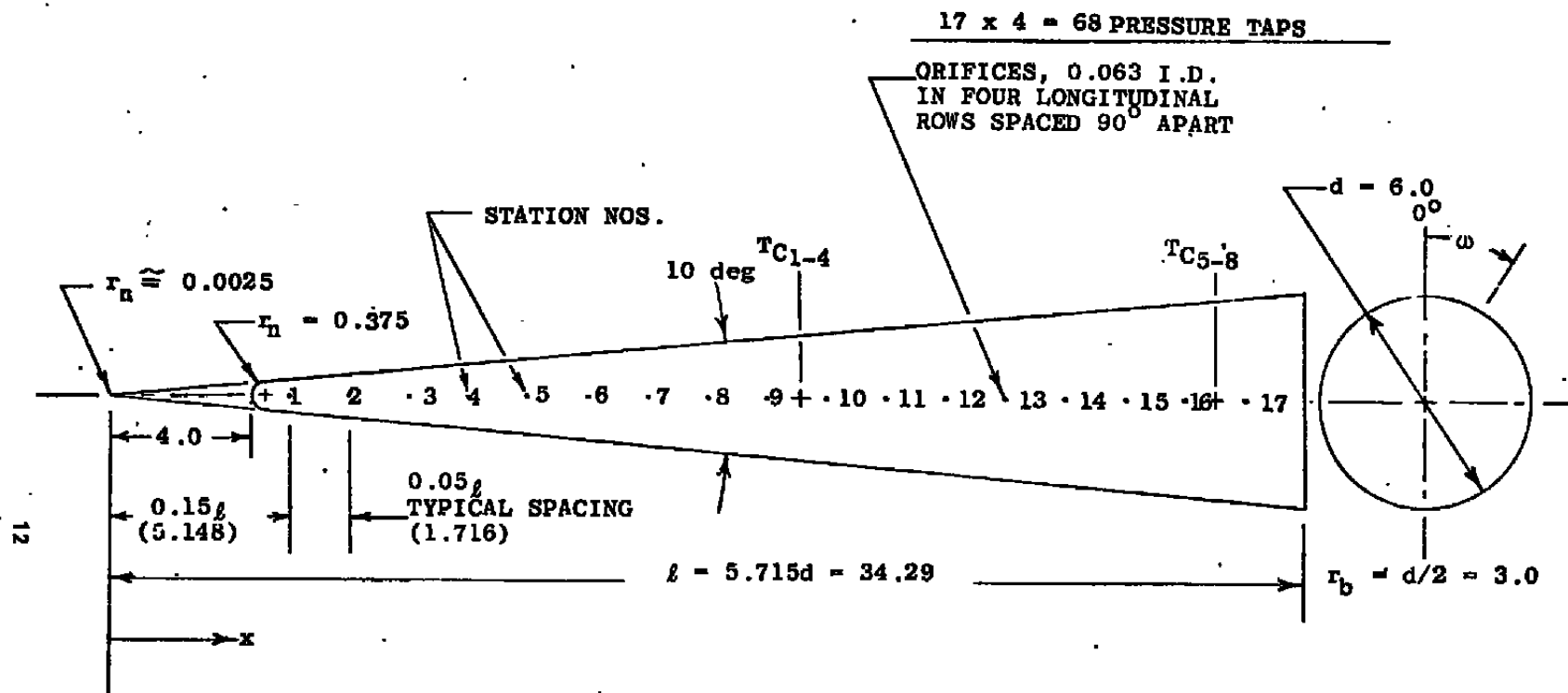


Fig. 2 VKF Standard Cone - Pressure Model

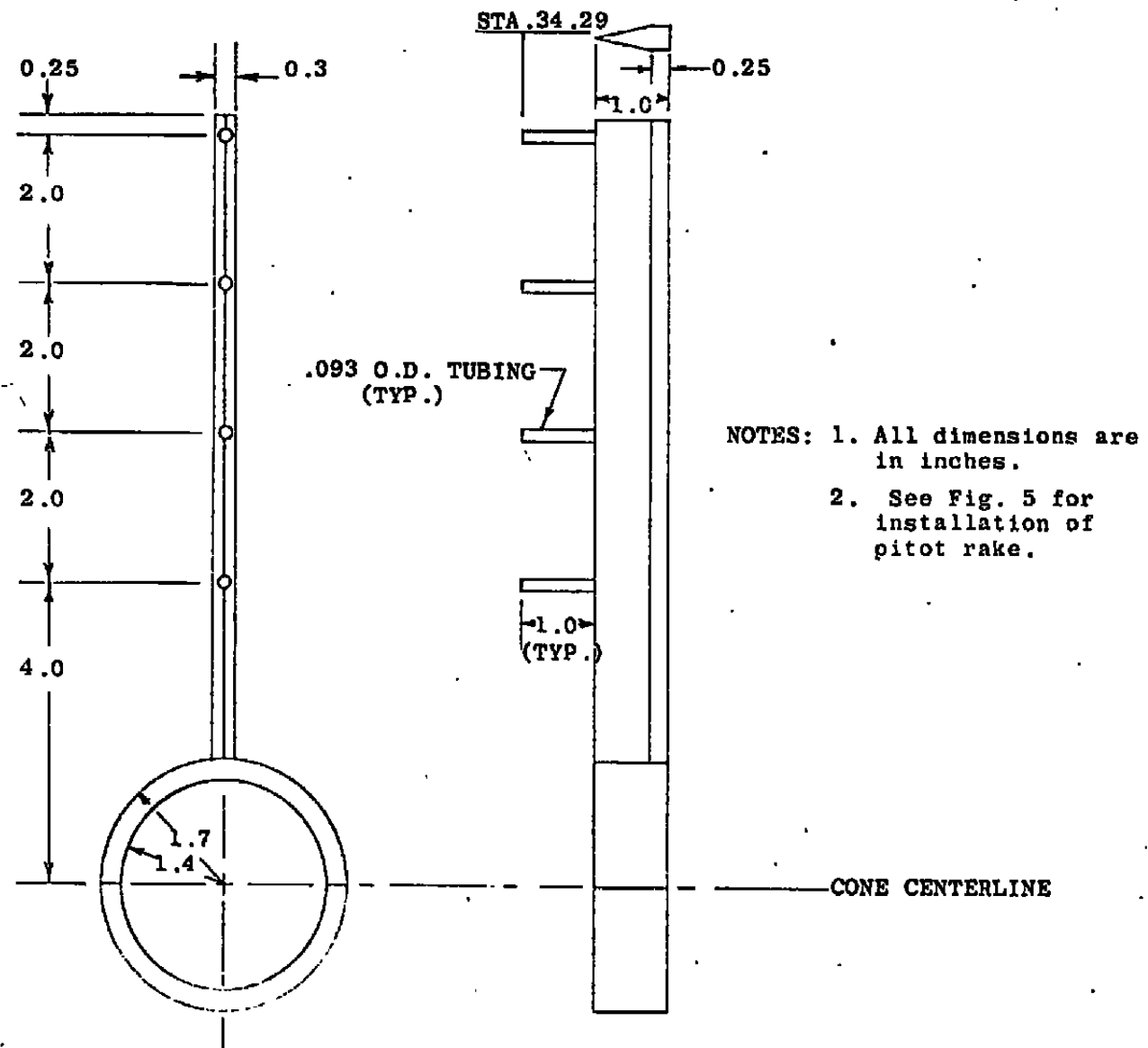


Fig. 3 Sketch of Pitot Rake

All linear dimensions in inches

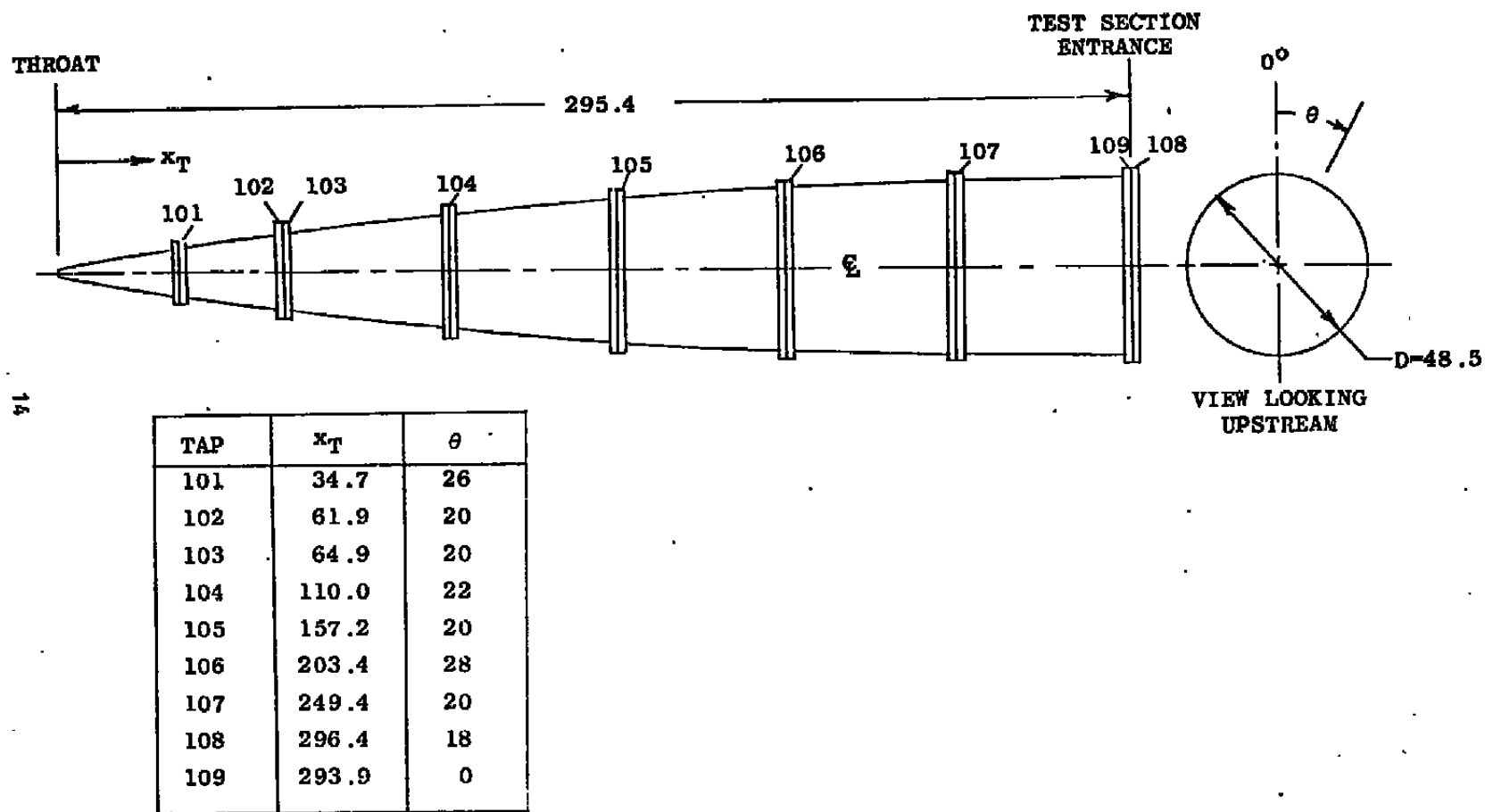


Fig. 4 Pressure Taps in Mach 10 Nozzle - Tunnel C

459

50-INCH HYPERSONIC TUNNELS B&C

SCALE-1/3

TUNNEL WALL

ROLL HUB
STA. 0.00

AFT. C.R.
STA. 29673

NOM. C.R.
STA. 45673

FWD C.R.
STA. 59673

MAX. FWD. PT.
STA. 69673

STA. 55.923

STA. 35.423

STA. 34.29

PITOT RAKE
(See Fig. 3)

1.06-2-11-000

1.06-2-31-007

1.06-2-31-022

1.06-2-32-007

1.06-2-11-002

WIND TUNNEL STING & MODEL

4.8"

15

TUNNEL WALL

Fig. 5 Cone Model Installation in Tunnel C

APPENDIX II

TABLES

TABLE 1. STANDARD CONE ORIFICE IDENTIFICATION

MODEL STATION	x, * INCHES	TAP NUMBERS			
		ω , deg			
		0	90	180	270
Nose Joint	4.29				
1	5.14	1	2	3	4
2	6.86	5	6	7	8
3	8.57	9	10	11	12
4	10.29	13	14	15	16
5	12.00	17	18	19	20
6	13.72	21	22	23	24
7	15.43	25	26	27	28
8	17.15	29	30	31	32
9	18.86	33	34	35	36
10	20.58	37	38	39	40
11	22.29	41	42	43	44
12	24.00	45	46	47	48
13	25.72	49	50	51	52
14	27.43	53	54	55	56
15	29.42	57	58	59	60
16	30.86	61	62	63	64
17	32.58	65	66	67	68
Base	34.29				
		THERMOCOUPLE NUMBERS			
	19.82	1	2	3 ⁺	4 ⁺
	31.75	5	6 ⁺	7	8

* See Fig. 2

+ Thermocouples used on this test

TABLE 2. TUNNEL C VALVE HOOK-UP

VALVE	CHAN.	POSITION						
		3	4	5	6	7	8	9
		NOZZLE, P_n	RAKE, P_p AND CONE, P_s	-CONE, P_s				
1	1	101	$P_p 1$	1	3	2	4	
	2	102	$P_p 2$	5	7	6	8	
2	3	103	$P_p 3$	9	11	10	12	
	4	104	$P_p 4$	13	15	14	16	
3	5	105		17	19	18	20	
	6	106		21	23	22	24	
4	7	107	65	25	27	26	28	
	8	108	66	29	31	30	32	
5	9	109	67	33	35	34	36	
	10		68	37	39	38	40	
6	11		TANK	41	43	42	44	
	12			45	47	46	48	
7	13			49	51	50	52	
	14			53	55	54	56	
8	15			57	59	58	60	
	16			61	63	62	64	

Channel No.

16	15	1	2
14	13	3	4
12	11	5	6
10	9	7	8

Looking Downstream
on Pressure Package

Port No.

4	6	8	
3	5	7	9

Looking Into
Hook-up Ports

TABLE 3. TEST SUMMARY

Re_{∞}/ft $\times 10^{-6}$	T_{DP} , °F	P_o , PSIA	T_o , °R	GROUP NUMBER		
				NOZZLE WALL STATIC PRESSURES	PITOT RAKE PRESSURES	CONE SURFACE PRESSURES
0.66	-47	490	1800	65	66	
1.0	-44	490	1440	63	64	
1.4	7	1465	2140	28,32		
	7		2160		29,30	31
	-8		2130	33		
	-10		2150	34		
	-15	1470	2160	35		
	-21	1465	2150	36,37	38	39
	-28		2160	59	60*	
	-30			41		
	-38			84,87	85	86
	-48			46	47	48
	-55		2150	50	51	52
	-57		2160	53	54*,88	55*,89
	-60	1470	2160	56,90,91	57*	58*
	-66	1460	2155	76	77	78
	-66	1465	2165	80,83	81	82
1.5	-58	1460	2100	70	71	72
1.6	10	1470	1980	25	26	
1.7	-46	1465	1965	73		
1.7	-54	1465	1970		74	75
1.8	12	825	1350	6	7*	8*
1.9	11	825	1300	5		
2.0	19	1465	1800	18,21,24	19	
2.4	13	1470	1630	15	16	
2.9	16	1465	1440	12	13	
3.1	14	1450	1400	11		
3.5	0	780	890	4		
3.7	13	1480	1275	10		
4.1	10	1420	1160	9		
0.4	-34	400	2080	43,44,45		
6.9	3	1330	820	3		
8.8	-2	1450	750	2		

* Sharp nose on cone model

TABLE 4. CONFIGURATION CODES

CODE NUMBER	CONFIGURATION		VALVE POSITION
	TYPE	TABULATED DATA PRINTOUT	
1	Sharp Cone	SCONE	5-8
3	Blunt Cone	BCONE	5-8
5	Tunnel Nozzle	NOZZLE	3
7	Pitot Rake	RAKE	4

APPENDIX III

SAMPLE TABULATED DATA AND DATA NOMENCLATURE

1. TABULATED DATA NOMENCLATURE

ALPHA	Angle of attack of cone, deg
CF1,CF2,CF3	Real gas correction factors used in Tunnel C for P-INF, T-INF, PO PRIME, respectively
CODE	Configuration code
CONFIG	Configuration
GROUP	Data group number
MACH	Free-stream Mach number
PAGE	Data tabulation page number
PO	Tunnel stilling chamber pressure, psia
PO PRIME	Stagnation pressure calculated downstream of a normal shock, psia
POSITION	Tunnel C standard pressure system valve position
P-INF	Free-stream static pressure, psia
PN/PO	Ratio of tunnel nozzle wall pressures to PO
PP/PO	Ratio of rake pitot pressures to PO
PS/PO	Ratio of cone surface static pressure to PO
Q-INF	Free-stream dynamic pressure, psia
RE-INF/FT	Free-stream Reynolds number per ft
TANK	Tank pressure ratioed to PO
TC-3 thru TC-6	Cone wall temperatures, °R
TDP(CRL)	Tunnel stilling chamber dewpoint temperature, °F (Cambridge instrument)
TIME	Hour-Minute-Second of data
TO	Tunnel stilling chamber temperature, °R
T-INF	Free-stream static temperature, °R

ARO, INC - AEDC DIVISION
A SYNERGUP CORPORATION COMPANY
VON KARMAN GAS DYNAMIC FACILITY
ARNOLD AIR FORCE STATION, TENN

AEDC/DOE FLOW DIAGNOSTICS APPLICATIONS

PROJECT NO V41C-V5A

DATE COMPUTED 26-JUL-78
DATE RECORDED 27-JUN-78
TIME RECORDED 0:26:11

PAGE 1

GROUP 2	WACH 10.14	CODE 5	CONFIG NOZZLE	CF1	CF2	CF3	PO PRIME		P-INF	Q-INF	T-INF	RE-INF/FT	POSITION 3
				1.0752	0.9854	1.0642	4.41						
				1452.7	745.	TDP(CPL) -2.	0.034	2.417			34.0	0.878E+07	
----- TUNNEL NOZZLE TAPS PN/PO = 100000 -----													
TIME	PO										TO		
-----	-----	101	102	103	104	105	106	107	108	109	-----		
0 26 11	1452.7	97.70	32.85	32.11	13.33	8.30	6.75	5.95	5.78	5.48		745.	
0 26 38	1453.7	97.29	32.72	32.05	13.34	8.30	6.75	5.94	5.79	5.49		750.	
0 27 1	1453.2	96.90	32.69	32.02	13.33	8.28	6.73	5.93	5.77	5.47		750.	
0 27 19	1454.2	96.54	32.50	31.77	13.24	8.24	6.68	5.88	5.72	5.43		755.	
0 27 44	1453.9	95.84	32.46	31.78	13.23	8.23	6.67	5.87	5.71	5.42		759.	

a. Tunnel Nozzle Wall Pressure

GROUP 2 PAGE 1

2. SAMPLE TABULATED DATA

PAGE 5

GROUP	MACH	CODE	CONFIG	CF1	CF2	CF3	PD PRIME	P-INF	Q-INF	T-INF	RE-INF/FT	POSITION
78	10.14	3	BCONE	0.9452	1.0654	0.9515	3.97	0.030	2.135	106.6	0.140E+07	7
				PO	TO	TDP(CRL)						
				1461.1	2158.	-86.						

PS/PO X 10000

TIME	PO	2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	ALPHA
5 9 45	1453.9	0.979	0.616	0.501		0.457	0.426	0.445	0.441	0.472	0.455	0.461	0.470	0.474	0.474	0.492		0.02
5 9 56	1463.9	0.987	0.610	0.501		0.443	0.432	0.440	0.449	0.461	0.458	0.466	0.477	0.478	0.478	0.493		0.03
5 10 7	1463.9	0.988	0.609	0.502		0.437	0.435	0.440	0.452	0.457	0.459	0.484	0.479	0.479	0.479	0.493		0.03
5 10 18	1455.4	0.967	0.607	0.503		0.433	0.435	0.444	0.453	0.453	0.459	0.481	0.478	0.477	0.479	0.491		0.03
5 10 29	1454.1	0.990	0.608	0.503		0.432	0.437	0.444	0.454	0.453	0.460	0.472	0.479	0.478	0.479	0.493		0.03
5 10 39	1465.1	0.990	0.608	0.502		0.431	0.437	0.445	0.454	0.456	0.460	0.481	0.479	0.479	0.479	0.492		0.03

CGME CIRCUMFERENTIAL LOCATION: 90 DEG

Note: This is a typical page from a multiple page tabulation

ARO, INC - AEDC DIVISION
A SYVERDRUP CORPORATION COMPANY
VON KARMAN GAS DYNAMIC FACILITY
ARNOLD AIR FORCE STATION, TENN

AEDC/DOTR FLOW DIAGNOSTICS APPLICATIONS

DATE COMPUTED 26-JUL-78
DATE RECORDED 7-JUL-78
TIME RECORDED 5: 5144

PROJECT NO V41C-V5A

PAGE 2

				CF1	CF2	CF3	PD PRIME						
				0.9454	1.0652	0.9517	2.97						
GROUP	MACH	CODE	CONFIG	PD	TD	TDP(CRL)	P-INF	Q-INF	T-INF	RE-INF/FT	POSITION		
77	10.14	7	RAKE	1462.4	2155.	-66.	0.030	2.138	106.4	0.140E+07	4		
PF/PO = 100				PS/PD = 10000				CONE WALL TEMPERATURES					
TIME	PO	PP1	PP2	PP3	PP4	65	66	67	68	TANK	TC-3	TC-4	TC-6
5 5 44	1462.4	0.471	0.289	0.288	0.286	0.487			0.532	1.054	856.	851.	866.
5 5 55	1461.9	0.471	0.289	0.289	0.286	0.493			0.526	1.056	860.	855.	871.
5 6 6	1461.8	0.472	0.289	0.289	0.286	0.495			0.522	1.046	864.	859.	875.
5 6 17	1461.9	0.472	0.289	0.289	0.286	0.497			0.520	1.051	868.	864.	879.
5 6 27	1460.9	0.473	0.289	0.289	0.287	0.499			0.520	1.052	872.	868.	883.
5 6 38	1461.1	0.473	0.289	0.289	0.287	0.499			0.518	1.051	875.	871.	886.

c. Pitot Rake Pressure, Cone Surface Pressure,
and Cone Temperature

GROUP 77 PAGE 2

2. Concluded